Zombie Data from Babylon

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Empirical results can sometimes be fruitfully repurposed across epistemic contexts. Sometimes this happens in a single historical context, as when the same research outputs are shared between different contemporaneous groups investigating different phenomena, or when the same research is used to rule against several alternative theories. In addition, empirical results can sometimes be repurposed in new historical contexts—old data can be revived and given new life. Philosophers of science have discussed such cases of zombie data in biology, archaeology, and paleontology (cf. Leonelli 2017, Wylie 2017, Currie and Turner 2016, and Currie 2016). Having the capacity to use empirical results in contexts besides those that generated them is also critically important for studying some astronomical phenomena. Historical astronomical observations can be valuable, sometimes irreplaceable, for certain research questions. For instance, some astronomical events are rare enough that few occurrences have been witnessed since the advent of the telescope (such as nearby supernovae), let alone since the adoption of contemporary conceptual categories or recent data distribution practices. And some phenomena of interest change subtly over very long periods of time. In order to study such phenomena, researchers have implemented clever strategies for coaxing historical astronomical records into epistemic contact with contemporary theory.

I argue that, in general, in order for some empirical result to serve as a constraint on theorizing in some epistemic context, it must be "well-adapted" to the context of constraint. I defend a precise characterization of well-adaptedness and articulate one strategy by which an empirical result can be repurposed in a new context—using data records and their provenance metadata as the basis for transforming the empirical results codified in those records into useful empirical constraints in the contexts of interest. I present a virtuoso example of this strategy in action—the successful transformation of Babylonian eclipse records (from cuneiform script on broken clay tablets conveying observations recording in utterly defunct spatial temporal units) into useful constraints on the evolution of the length of the Earth's day. The length of a day on Earth has, it turns out, been slowing down. The Babylonian eclipse records have helped to put empirical pressure on the idea that the slowdown could be due entirely to tidal breaking from the Earth's gravitational interaction with the Moon, and instead appears to require contributions from other geophysical processes.

I develop the notion of "evidential forensics" to capture the clever chains of inference that researchers employ to render these historical records epistemically useful in the present. In particular I discuss three aspects of evidential forensics: assessment of relevance, translation/transformation of information, and circumstantial reasoning. First, in the case of an exemplary Babylonian eclipse record, certain desiderata that researchers have identified as requisite for an historical record to be useful as a constraint in this context were met. For instance, it must be possible to determine the geographical location from which the observation was made, the observation must be of an event in the solar system so that it is possible to calculate the timing of the event in terrestrial time from the applicable dynamical equations, it must be possible to determine the exact date of the observed event, and it must be possible to determine the time of the even in universal time coordinates (Stephenson and Morrison 1995, 171). Even if all of all of these desiderata are met, there is still the business of deciphering and translating the content of the records themselves to generate results that are well-adapted to the new context of interest. This involves, for instance, transforming observation records expressed in temporal units likely measured using a water clock referenced to the time to sunrise or sunset, and eclipse magnitudes given in si

(fingers), where 12 fingers spans the diameter of the disk of eclipsed body, that is, the sun or moon (Stephenson and Morrison 1995, 174).

Finally, researchers recruited background knowledge about the historical and cultural context in which the observations were originally made in order to make a plausible argument about the timing of a particular eclipse. In the virtuoso example I want to discuss, Stephenson et al. (2016) determine a constraint on the long-term slowing of Earth's rotation using a Babylonian record from 694 BC that states the Moon set while eclipsed. They argue: "Assuming an observer at an elevation of 10 to 15 m above the ground (the height of the walls of Babylon), and horizontal refraction as 34', the true lunar altitude, corrected for parallax, would need to be -0.°4 for the whole Moon to be visible" (ibid., 3). From the inferred timing of the moonset, they derived the difference between universal time and terrestrial time on that date.

I explore the parallels between the epistemology of this sort of evidential forensics with strategies in historiography and archaeology arguing that it shares some features characteristic of each, the most important being that the epistemic utility of the artifact depends crucially on the accessibility of details regarding its provenance.

References

Currie, Adrian and Derek Turner. (2016). Introduction: Scientific knowledge of the deep past. Studies in History and Philosophy of Science Part A 55: 43-46.

Currie, Adrian. (2016). The Swamp Zombie's Journey: Breathing New Life into Old Data. Extinct: The Philosophy of Paleontology Blog. http://www.extinctblog.org/extinct/2016/11/14/the-swamp-zombies-journey-breathing-new-life-into-old-data

Leonelli, Sabina. (accepted 2017). The Time of Data: Time-Scales of Data Use in the Life Sciences. Philosophy of Science.

Stephenson, F. R. and L. V. Morrison (1995). Long-Term Fluctuations in the Earth's Rotation: 700 BC to AD 1990. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 351(1695), 165–202.

Stephenson, F. R., L. V. Morrison, and C. Y. Hohenkerk (2016). Measurement of the Earth's rotation : 720 BC to AD 2015: The Supplement. Proceeding of the Royal Society A

Wylie, Alison. (2017). How Archaeological Evidence Bites Back: Strategies for Putting Old Data to Work in New Ways. Science, Technology, & Human Values 42(2): 203-225.